

PCT

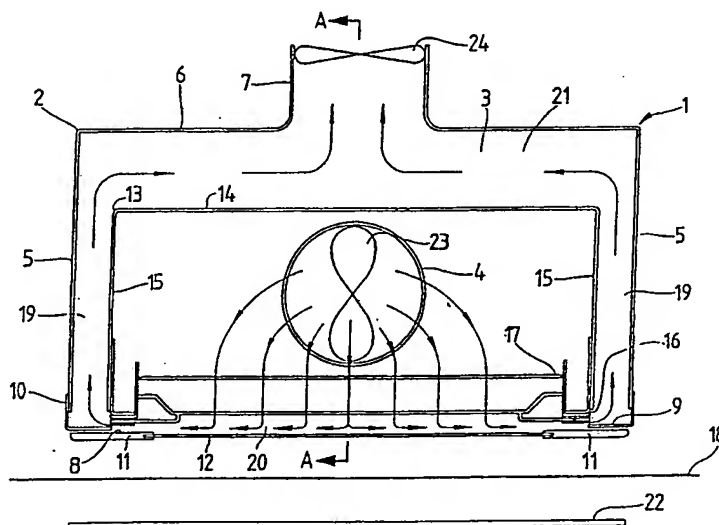
WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

|  |           |  |
|--|-----------|--|
| <p>(51) International Patent Classification 4 :<br/>D21F 5/16, F26B 3/30</p>   | <p>A1</p> | <p>(11) International Publication Number: WO 89/ 05883<br/>(43) International Publication Date: 29 June 1989 (29.06.89)</p>  |
| <p>(21) International Application Number: PCT/SE88/00675<br/>(22) International Filing Date: 13 December 1988 (13.12.88)<br/>(31) Priority Application Number: 8705033-2<br/>(32) Priority Date: 17 December 1987 (17.12.87)<br/>(33) Priority Country: SE<br/><br/>(71) Applicant (for all designated States except US): INFRARÖDTEKNIK AB (SE/SE); Regementsgatan 39, S-462 00 Vänersborg (SE).<br/>(72) Inventor; and<br/>(75) Inventor/Applicant (for US only) : HAMRIN, Karl-Arvid (SE/SE); Jägaråsen 36, S-736 00 Kungsör (SE).<br/>(74) Agent: SIEBMANN, Hubertus; Götalands Patentbyrå AB, Box 154, S-561 22 Huskvarna (SE).</p> |           | <p>(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BG, BJ (OAPI patent), BR, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CM (OAPI patent), DE, DE (European patent), DK, FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC, MG, ML (OAPI patent), MR (OAPI patent), MW, NL, NL (European patent), NO, RO, SD, SE, SE (European patent), SN (OAPI patent), SU, TD (OAPI patent), TG (OAPI patent), US.<br/><br/>Published<br/>With international search report.<br/>In English translation (filed in Swedish).</p> |

(54) Title: APPARATUS FOR HEAT TREATMENT OF MATERIAL, PARTICULARLY INFRA-RED RADIATION OF A CONTINUOUS PAPER WEB IN A PAPER MACHINE



(57) Abstract

Apparatus (1) for treatment of a continuous paper web (18) in a paper machine by means of infra-red radiation, comprising, in parallel relation to the paper web, infra-red heaters (17), which are separated from the paper web by protection panes (12), a cooling air system being provided to cool infra-red heaters and protection panes. The protection panes (12) are arranged by way of a series of separate panes overlapping each other and forming ventilation gaps (27), which are directed substantially in parallel relation to the web in the same direction or in two opposite directions (Figs. 1 and 2).

***FOR THE PURPOSES OF INFORMATION ONLY***

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

|    |                              |    |  |    |                          |
|----|------------------------------|----|--|----|--------------------------|
| AT | Austria                      | FR | France                                   | ML | Mali                     |
| AU | Australia                    | GA | Gabon                                    | MR | Mauritania               |
| BB | Barbados                     | GB | United Kingdom                           | MW | Malawi                   |
| BE | Belgium                      | HU | Hungary                                  | NL | Netherlands              |
| BG | Bulgaria                     | IT | Italy                                    | NO | Norway                   |
| BJ | Benin                        | JP | Japan                                    | RO | Romania                  |
| BR | Brazil                       | KP | Democratic People's Republic<br>of Korea | SD | Sudan                    |
| CF | Central African Republic     | KR | Republic of Korea                        | SE | Sweden                   |
| CG | Congo                        | LI | Liechtenstein                            | SN | Senegal                  |
| CH | Switzerland                  | LK | Sri Lanka                                | SU | Soviet Union             |
| CM | Cameroon                     | LU | Luxembourg                               | TD | Chad                     |
| DE | Germany, Federal Republic of | MC | Monaco                                   | TG | Togo                     |
| DK | Denmark                      | MG | Madagascar                               | US | United States of America |
| FI | Finland                      |    |  |    |                          |

Apparatus for heat treatment of material, particularly infra-red radiation of a continuous paper web in a paper machine.

The present invention relates to an apparatus for heat treatment of material, particularly infra-red radiation of a continuous paper web in a paper machine and is more closely defined in the preamble of claim 1.

5

It is previously known to expose e.g. a continuous paper web in a paper machine to infra-red radiation for drying the web wholly or partially. Hereby, the infra-red radiation creates a great heat potential, which entails the need for cooling the radiation and protection of the paper web against smear spots and other pollution, the risk of fire and unequal drying. For achieving such a protection, supply and/or exhaust air currents are used, which affect the radiation and the paper web. These currents are provided to bring about guaranteed cooling, but without minimizing the efficiency of the drying process and without adversely affecting the path of the web, respectively. These demands have, so far, not been met by previously known techniques.

Such apparatuses do often comprise a s.c. counter reflector provided to throw back part of the heat radiation having passed through the paper against same. It is desirable, for making the drying process more efficient, to arrange the counter reflector as close to the paper web as is possible. Hitherto, the counter reflector had, however, to be arranged at relatively large distance to the paper web, for various reasons, which brought about decreased efficiency. The same applies to the reflector itself with the radiation source which, mainly because of security reasons, had to be arranged at relatively large distance from the paper web in previously known apparatuses, which rendered a clearly worse degree of efficiency. Of major importance in this connection is, however, the guidance of the web, which so far, for certain combinations of paper weight, structure, moisture contents, free length in the direction of the web etc, has been adversely affected by reflectors arranged too closely nearby, because of negative affects of the cooling air currents on the web. Further drawbacks of known techniques are great waste of power, difficulties to perform maintenance and service, maintaining an equal degree of efficiency and need for frequent service.

The object of the invention is to provide an improved apparatus of the kind as initially defined, which avoids the said drawbacks. A superior purpose of the invention is to provide a basis for using the components comprised by the apparatus as efficiently as possible, to increase the level of efficiency substantially and to provide, in spite of these advantages, the same or even increased security. A further object of the invention is to improve techniques in this field in various other respects.

10 These objects are achieved according to the invention in that an apparatus of the kind as initially defined substantially is characterized by the features of the characterizing clause of claim 1. Thanks to these features, it is possible to arrange the radiator with the reflector very close to e.g. a paper web, namely, according to obtained test results, at 20 mm distance between protective  
15 glas panes and a paper web, which is to compare with app. 50 mm according to previously known technique. In such a way, a much more extensive drying is, of course, obtained and the level of efficiency may be increased further by arranging even the counter reflector  
20 closer to the web. In spite of these features, it is possible to ensure an advantageous web guiding, which is not or only negligibly affected by e.g. air currents. Said features do also safeguard that the apparatus is, as far as possible, kept free from dirt. The lack of substantial free air currents brings about a degree of  
25 purity which is unknown so far, and which considerably increases both efficiency and safety.

Furthermore, the concept of overlapping protective panes offers the advantage, that tolerances and thermal expansion won't affect the  
30 tightness of the assembled glas surface.

Further characteristics of and advantages with the invention are revealed by the following specification with reference to the accompanying drawings which, schematically, illustrate a preferred, though,  
35 not limiting example.

Fig. 1 is a cross-sectional view of an apparatus according to the invention,

- Fig. 2 is a sectional view according to line A - A in Fig. 1 illustrating conditions at relatively low pressure,  
Fig. 3 is a view corresponding to Fig. 2 at relatively high pressure,  
Fig. 4 is a partial view of the embodiment according to Fig. 2 or an  
5 embodiment between Fig. 2 and 3,  
Fig. 5 is a view corresponding Fig. 4 of a modified embodiment,  
Fig.s 6 and 7 are a side elevational view and a top plan view, respectively, of a preferred embodiment of a pane holder.
- 10 In Fig. 1, 1 designates a preferred embodiment of an apparatus according to the invention in its entirety. The apparatus comprises e.g. an elongated exterior housing 2 provided in one end wall 3 with an inlet 4, side walls 5 and a top side 6 with an outlet 7. Lowermost the exterior housing shows an opening 8 occupying substantially the  
15 underside and laterally limited by narrow flanges 9, which preferably are provided at a border 10 extending all-around the side walls 5 and the end walls 3 and permitting easy and complete access to the interior of the exterior housing.
- 20 From below, pane holders 11 are attached to the flanges 9 and carry panes 12, which in principle cover the opening 8. Appearance and function of the pane holders will be more closely described in connection with Fig. 2 - 5.
- 25 Between the end walls 3, there extends an interior housing 13 with top side 14, side walls 15 and a lower opening 16, which is occupied by infra-red heaters 17 with reflectors (not shown) inserted into the interior housing and facing a paper web 18, which is guided outside of the panes 12 and parallel to these. The web runs to the left  
30 or to the right in Fig. 1.

The side walls 15 of the interior housing are arranged at distance from the side walls 5 of the exterior housing in order to provide exhaust air passages 19, which connect a lower supply air zone 20  
35 between said heaters 17 and the inside of the panes 12 to an upper merging passage 21 between the top sides 6 and 14, which merging passage extends into said outlet 7 to lead away the exhaust air. The supply air and the exhaust air are thus guided in a closed system.

Herein, the supply air is preferably filtered before entering the apparatus according to the invention. The exhaust air may wholly or partly be used in e.g. heat exchangers or other energy using devices. The exhaust air is supplied in a pure state and does not  
5 require filtering, accordingly. The housings are suitably made of stainless steel.

On the reverse side of the paper web, there is preferably provided a counter reflector 22, which is previously known per se and has  
10 the objective to throw back the major part of the radiation which has penetrated the paper web and in this way heat up the latter even on that side which is turned away from the heaters 17. Thanks to the invention, even the counter reflector can be arranged relatively close to the paper web, e.g. 20 mm from same, while that  
15 distance previously was app. 50 mm.

As revealed by Fig. 1, the supply air is distributed from the inlet or inlets 4 around and/or through the heaters 17 and through the supply air zone 20, which thus becomes a cooling zone, towards both  
20 sides 5. The pressure of the supply air may easily be adjusted in that the inlet 4 is connected to a fan 23 generating excess pressure and/or in that the outlet 7 is connected to a fan 24 generating a vacuum. Possibly, a fan for the exhaust air is unnecessary thanks to the invention.

25 According to another, substantial feature of the invention, the panes 12 are arranged in series throughout the length of the exterior housing, i.e. at right angle in relation to the sheet plane of Fig. 1. The panes bridge the entire distance between the juxtaposed pane holders 11 in one piece and have thus a length of  
30 250 - 600 mm, preferably app. 350 mm. The width is preferably 100 - 300 mm only, suitably app. 150 mm. This width shows up in Figs 2 and 3, which also reveal another important feature of the invention, namely that the longside regions 25, 26 of the panes  
35 overlap each other. The overlap is such, that gaps 27 are formed which either all of them point in the same direction or, for instance, commencing at the center of the apparatus, point in opposite directions.

The pane holders 11 are shown schematically only in Figs 2 and 3. They may be provided in a continuous way for receiving any number of panes or e.g. a pane each. They are furnished with a groove 29 for receiving the pane or panes. This groove may be so wide, that  
5 an overlap is possible within the groove, i.e. the groove is at least twice as wide as the thickness of the panes. It is also possible to provide several grooves 29, one for each pane, and/or may the grooves and/or the pane holders be oblique in a way as illustrated by the grooves 29 in Fig. 6. Furthermore, within or outside  
10 of the grooves and at their lower end there may be stop means 30, which limit insertion of the panes in this direction. According to a special embodiment of the invention, these stop means may be provided to form or prolong or limit or affect, respectively, wholly or partly said gaps 27. A preferred embodiment is shown in Figs  
15 6 and 7, where the holders form, in the direction of inclination, a lower projection 31, on which there is provided to rest an upper projection 32 arranged at the opposite side of the holders. The front edge of the lower projection 31 and the matching edge of the upper projection 32 may preferably be oblique for easier fitting in.

20

The edges of the panes entering the grooves 29 may be furnished with some kind of lining, packing or the like (not shown), which may have a certain elasticity for desirable adjustment or regulation of the width of the gaps 27. In principle, at low pressure drop via  
25 the gaps 27, the panes attain a position according to Fig. 2, where supply air leaks through the gaps 27 in a controlled way. The flow points in the same direction and somewhat away from the panes and somewhat towards the paper web, which may be advantageous in certain cases. Mostly, a control according to Fig. 3 or closely to Figs  
30 3, 4 or 5 may, however, be preferred. Herein, most a relatively large pressure drop prevails via the gaps 27, which decrease in width simultaneously due to this pressure drop, as the superposed pane area 25 is pushed down towards the underlying area 26 of the adjacent pane by the pressure. In this way, an automatic self-ad-  
35 justment is always achieved, which cannot be affected even by wear and tear as time goes by. Within the gap itself, a lower pressure arises, thanks to which the pane areas superimposing each other are so to speak sucked towards each other. Through the very narrow

remaining gap, high velocity air currents 35 are pushed out in parallel relation to that side of the panes which faces the paper web, which pane sides simultaneously are kept clean and cooled thanks to these currents, which benefit, due to velocity and substantial momentum, from the s.c. coanda effect, i.e. that an air current is sucked towards a confinement by the arising vacuum. The volume of these air currents is however, so little, that the guidance of the web is not adversely affected in any way. An advantage in this connection is also, that the partial currents assist each other by a combined sucking and pushing effect. The power of a partial stream may therefore not be chosen in such a way, that the stream or current easily and quickly can leave the region between panes and paper web, which likely could give rise to turbulences entailing interferences in the guiding of the web. Very favourable is the laminar flow of air between panes and paper web. At high pressure drop, the flow direction is, as has been said, substantially parallel to the panes, which may be further improved by narrow and possibly long gaps, which are achievable by choosing longer overlap zones. At low pressure drop, it may be favourable to direct the air currents slightly more towards the paper web for better breaking up a steam layer surrounding the web. This flow pattern may accordingly be controlled, among other means, by control of the pressure drop. Naturally, there may be provided special means for increasing/decreasing the width of the gaps, e.g. by way of s.c. pivot points 36, around which the panes may turn or be turned simultaneously increasing or decreasing the gap width. Another means may be shaping the pane edges within the overlap zones, e.g. by bevelling and/or curving which, to a certain degree, may have the effect of diffusing and/or increasing velocity. The pane edges may also, in these areas, be ground in a special way to form, in combination, a certain desired jet design and thus render an increased length of throw respectively velocity at a certain difference of pressure. Even in this way, the length of the gaps may be controlled.

Thanks to the invention, panes and infra-red heaters may readily be for instance exchanged, which is a favourable spin-off effect:



of the invention, which is to be compared with removing a large pane with many points of attachment, large weight and other discomfort.

- 5 It will be appreciated, that the panes may be arranged alternately at different levels which, admittedly, will result in pairs of air currents pointing in opposite directions, which currents may, however, be designed differently or is it possible to obstruct one gap formation.

CLAIMS

1. Apparatus (1) for heat treatment of material, particularly, infra-red radiation of a continuous paper web (18) in a paper machine, comprising a number of infra-red heaters (17) arranged in parallel relation to the paper web or the like and separated from the paper web by protection glass (12), a cooling air system being provided to cool infra-red heaters and protection glass, characterized in that the protection glass (12) is provided as a series of separate panes overlapping each other and forming ventilation gaps (27), which are directed substantially in parallel relation to the web in the same direction or in two opposite directions.
2. Apparatus according to claim 1, characterized in that it comprises a preferably elongated exterior housing (2) with an inlet (4) in one of the end walls (3) and with side walls (5) and a top side (6) with outlet (7) as well as lowermost an opening (8) occupying substantially the entire underside and laterally confined by flanges (9) which, preferably, are arranged at a border (10) surrounding the side walls (5) and the end walls (3).
3. Apparatus according to claim 2, characterized in that between the end walls (3) there extends an interior housing (13) having a top side (14), side walls (15) and a lower opening (16), which is covered by infra-red heaters (17) with reflectors inserted into said interior housing and facing a web or the like (18), which is guided outside the panes, preferably in parallel relation to the latter, and that the side walls (15) of the interior housing are arranged at distance from the side walls (5) of the exterior housing to form exhaust air passages (19), which interconnect a lower supply air zone (20) between said heaters (17) and the inside of the panes (12) with an upper merging passage (21) between the top sides (6) and (14), which merging passage connects to the outlet (7) for leading away the exhaust air.
4. Apparatus according to claims 1 - 3, characterized in that the flanges (9) are, from below, attached pane

holders (11) carrying the panes (12) which, in principle, cover the opening (8), and that on the reverse side of said material in relation to the housings, there is provided a counter reflector (22) which, preferably, is located relatively close to  
5 said material, e.g. 20 - 30 mm from same.

5. Apparatus according to claims 1 - 4, characterized in that the supply air is provided to flow from the inlet (4) and preferably through the heaters (17) and through the supply air  
10 zone (20) in order to design the latter as cooling zone, and towards both sides (5), and that the pressure of the supply air zone (20) is controllable by the inlet (4) being connected to a fan (23) generating excess pressure and/or by the outlet (7) being connected to a fan (24) generating a vacuum.

15 6. Apparatus according to claim 1, characterized in that the panes (12) are arranged in series along the length of the exterior housing, that the panes bridge the entire distance between opposite pane holders (11) in one piece, and  
20 that the pane holders (11), preferably, are designed throughgoing to hold any number of panes in combination or one pane each, alternately.

25 7. Apparatus according to claim 6, characterized in that the pane holders are equipped with a groove (29) to receive the pane or panes, respectively, which groove has such a width, that the overlap takes place within the groove, i.e. the groove is, at least, twice as wide as the thickness of the panes, or that there are several grooves (29), one for each pane,  
30 and / or that the grooves respectively the pane holders are arranged oblique.

8. Apparatus according to claim 7, characterized in that, within or outside of the grooves, at their end positioned  
35 most closely to said material, there are provided stop means (30), which limit insertion of the panes in this direction, and that these stop means, preferably, are provided to form,

to prolong or to limit or to affect, entirely or partly, said gaps (27).

5 9. Apparatus according to claim 7, characterized in that the pane holders form, in the direction of inclination, a lower projection (31), on which is provided to rest an upper projection (32) arranged at the opposite side of the pane holders, and that the front edge (33) of the lower projection (31) and the matching edge of the upper projection (32), preferably, are oblique for better fitting in.

10 10. Apparatus according to claim 7, characterized in that the edges of the panes entering the grooves (29), preferably, are furnished with a lining, packing or the like which, preferably, shows a certain elasticity for desirible adjustment or regulation of the width of the gaps (27), supply air being provided to leak through the gaps (27) in a controllable way with the flow in the same direction and directed slightly away from the panes and slightly towards said material, and / or that there is provided to prevail a relatively large pressure drop via the gaps 20 (27), the width of which is provided to diminish due to said pressure drop.

1/2

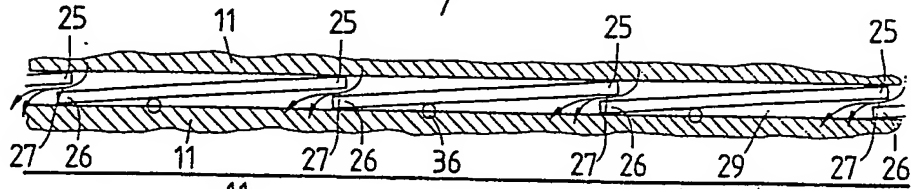


FIG. 2

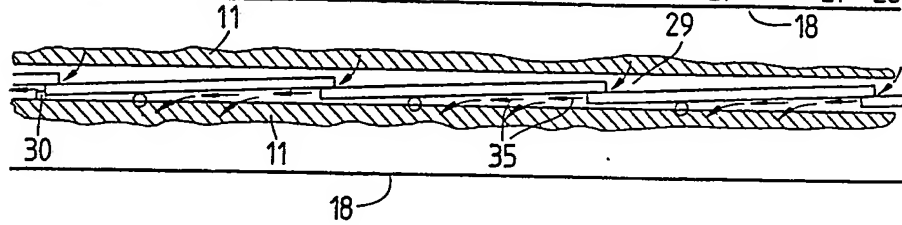


FIG. 3

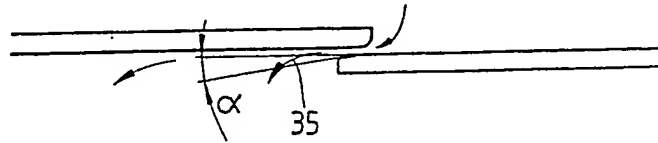


FIG. 5

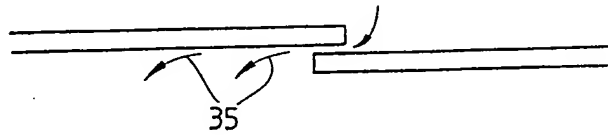


FIG. 4

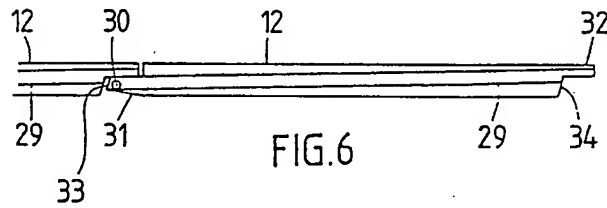


FIG. 6

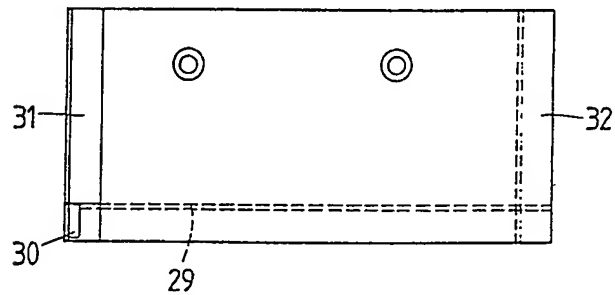
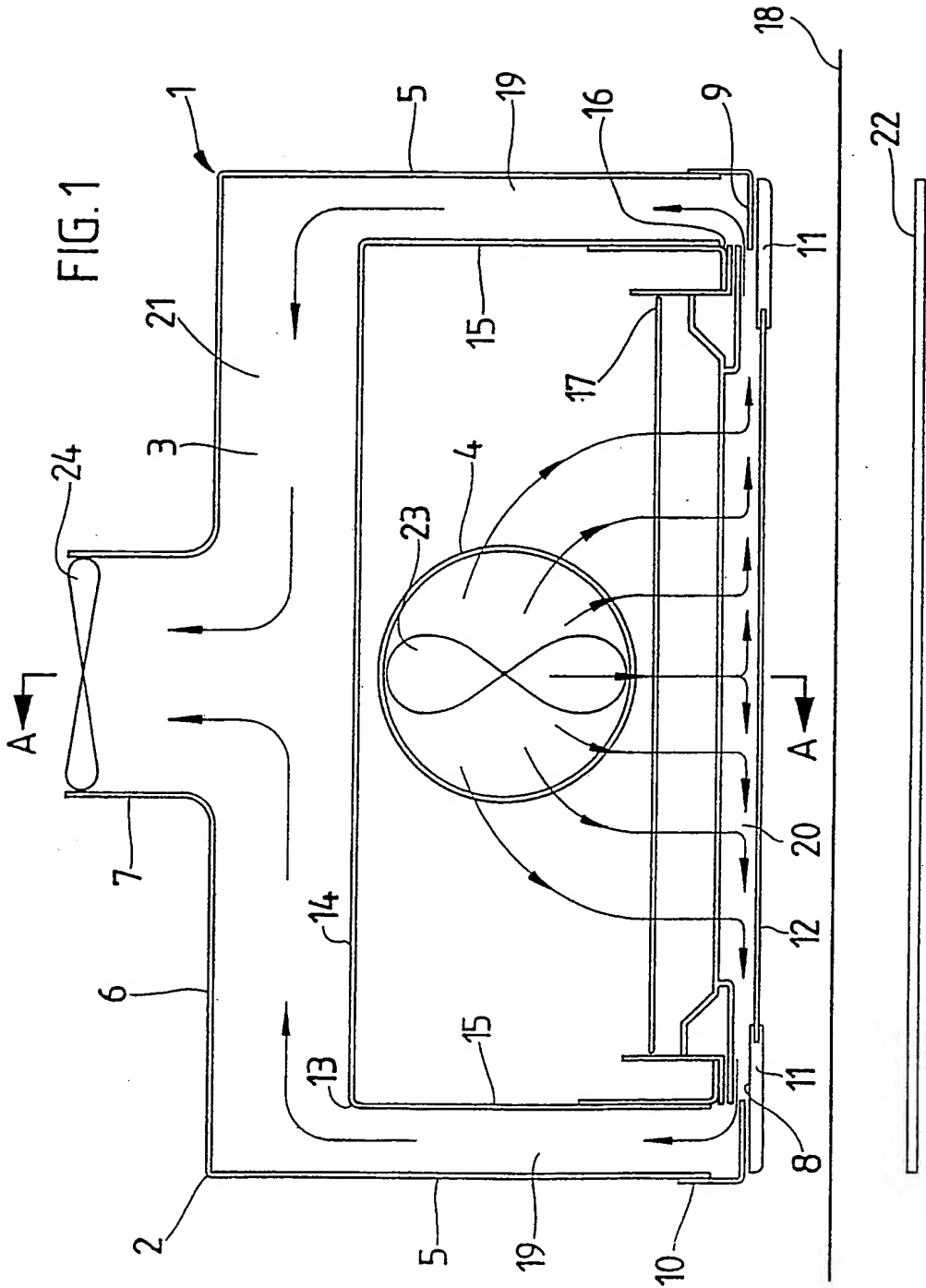


FIG. 7

2/2



# INTERNATIONAL SEARCH REPORT

International Application No PCT/SE86/00675

|   |  |
|---|--|
| <b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) <sup>1</sup>   |  |
| According to International Patent Classification (IPC) or to both National Classification and IPC <sup>4</sup>  |  |
| D 21 F 5/16, F 26 B 3/30  |  |
| <b>II. FIELDS SEARCHED</b>  |  |
| Minimum Documentation Searched <sup>7</sup>   |  |
| Classification System   | Classification Symbols   |
| IPC 4   | D 21 F 5/00,/16; F 26 B 3/30,13/10,/20,23/04,/06   |
| Nat C1  | 82a:34   |
| US C1   | 34:4,41,68   |
| Documentation Searched other than Minimum Documentation <sup>8</sup><br>to the Extent that such Documents are Included in the Fields Searched <sup>1</sup>  |  |
| SE, NO, DK, FI classes as above   |  |
| <b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b>   |  |
| Category <sup>6</sup>   | Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>   Relevant to Claim No. <sup>13</sup> |
| A   | WO, A1, 87/04739 (ITRONIC PROCESS AB)<br>13 August 1987  |
| A   | SE, B, 451 381 (IMPACT SYSTEMS INC.)<br>5 October 1987   |
| <p>* Special categories of cited documents:<sup>10</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubt on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p> |  |
| <b>IV. CERTIFICATION</b>  |  |
| Date of the Actual Completion of the International Search   | Date of Mailing of this International Search Report  |
| 1989-02-15  | 1989-03-02   |
| International Searching Authority   | Signature of Authorized Officer  |
| Swedish Patent Office   | Biörn Sailer   |